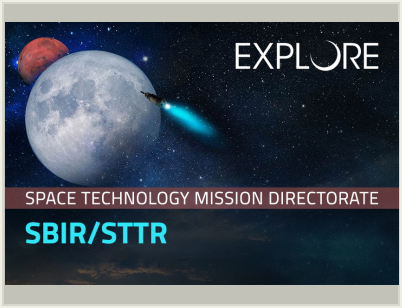
Very large computer generated holograms for precision metrology of aspheric optical surfaces, Phase I

Completed Technology Project (2012 - 2012)

Project Introduction

Both ground and space telescopes employ aspheric mirrors. A particular example is the X-ray telescope where primary and secondary mirrors have nearly cylindrical surfaces. Computer Generated Holograms (CGH), in combination with commercial interferometers, provide high resolution and high accuracy measurements of aspheric optical surfaces. The current state of the art CGHs are made on 6" square substrates such as those for testing the primary segments of James Webb Space Telescope. However, larger CGHs are always desired. A larger CGH enables testing of correspondingly larger convex and nearly cylindrical concave surfaces in one shot; studies have shown that larger CGHs also offer better imaging of the surface under test, which improves the CGH null test system's Instrument Transfer Function, an equivalent metric to an imaging system's Modulation Transfer Function. Furthermore, pursuit of improving CGH test accuracy never ends. The fundamental limiting factor is quality of the substrate. The current state of the art technology is still unable to fabricate general CGHs of arbitrary symmetry on high quality custom substrates. Arizona Optical Metrology LLC (AOM) proposes to address these problems. We propose to work with our collaborators at the ebeam facility of Jet Propulsion Laboratory of NASA to write large CGHs on high quality substrates. We anticipate the writing has reasonable yet non-negligible errors which cause errors in the aspheric wavefront the CGH produces. The wavefront error must be calibrated in order to meet the demanding accuracy requirement of precision aspheric surface metrology. We propose to develop a technology that enables accurate calibration of the writing error, such that the CGH still measures an aspheric surface to an excellent accuracy of a couple of nm rms. The goal of phase 1 is to develop the software tools for calibrating the CGH writing error, and fabricate a couple of 9 inch diameter CGHs to experimentally validate the technology.



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Small Business Innovation Research/Small Business Tech Transfer

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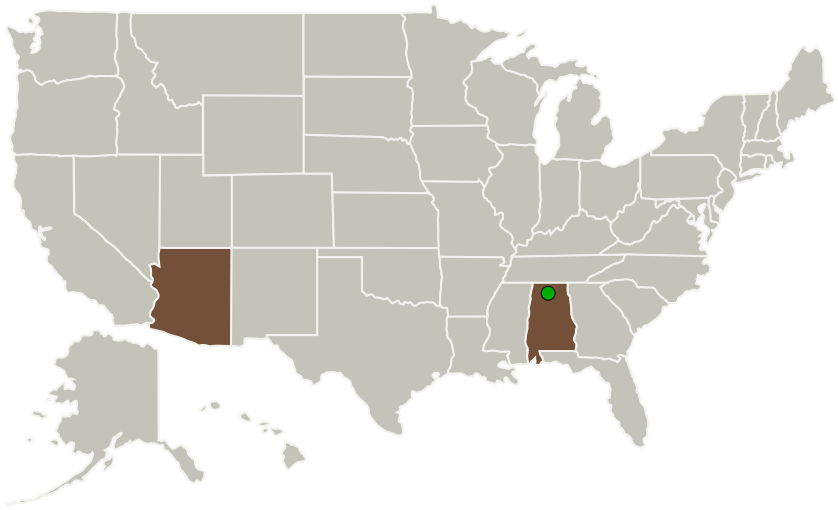
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Arizona Optical Metrology LLC	Lead Organization	Industry Minority-Owned Business	Tucson, Arizona
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Arizona

Project Transitions

February 2012: Project Start

September 2012: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138562)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Arizona Optical Metrology LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Chunyu Zhao

Co-Investigator:

Chunyu Zhao

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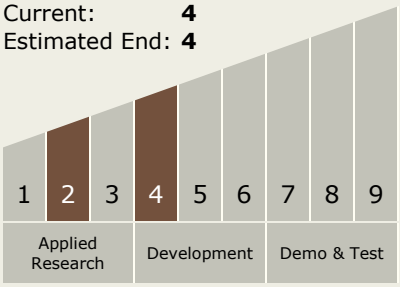
Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.3 Optical Components

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System